

MARK JENNESS -

RE: BIENNIAL REPORT, PART A

Overall, an impressive effort. I've made marks and comments within the text, which is enclosed. Additional comments are given below.

DESIGNATION AS AN AOC (pg. 6)

One might dispute that these land-based areas are significant sources of PCBs to the river. What is more significant, I believe, is the PCB already in the river from historical events or activities.

SUPERFUND SITE WITHIN AOC (pg. 7)

This section is confusing, because it mixes two Superfund sites, Auto Ion and Allied/Kazoo River. Is the intention to summarize only the latter? Auto Ion could be saved for the section on Contaminated Sites on page 21.

RESOURCE IMPAIRMENTS

Depending on what is stated in Part B, you might expand on the first and most obvious impairment, such as noting the advisory has existed since, what, 1977.

This may not be the place to question the other two impairments, but I will say a few words. I don't see how contamination alone (as opposed to physical change to a habitat) creates a habitat loss unless the contamination is so severe as to greatly impact populations. Guess I'll have to see the details in Part B.

Also, are any dredging restrictions official or formal like the fishing advisories, or is this just that one needs approval from the DNR before dredging? Dredging and similar disturbances certainly have been occurring.

PROGRESS TO DATE

You might expand on what has been done under the Allied/River Superfund project so far. As examples, the land-based operable units have been better characterized, floodplains generally have been found to be relatively clean (<1 ppm PCB in soil), and river characterization is being completed. You could call Scott Cornelius at the DNR for his perspective (517-373-7357).

I'll be out of the office this week, but you can leave voice mail at 649-9213 if you would like to discuss anything, and I'll call you back. See you on the 25th.

Bill Thacker *WET* 4-16-95

Part 1

Kalamazoo River Area of Concern

BIENNIAL REPORT

PART A: Description of the Resource

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**Prepared by the
Kalamazoo River Area of Concern
Public Advisory Council
Biennial Report Work Group**

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A Message from the Kalamazoo River Public Advisory Council

The Kalamazoo River Public Advisory Council (PAC) is a group of 23 local citizens representing a variety of stakeholders throughout the Area of Concern (AOC)--business, agriculture, landowners, hunting/fishing groups, government, public health agencies, educators, conservationists, and environmental activists. The PAC was established in May 1993 to assist and advise the Michigan Department of Natural Resources (MDNR) Remedial Action Plan (RAP) team with the development of the RAP, a plan to restore and protect the Kalamazoo River. PAC members are liaisons between the public and the RAP process. Additionally, PAC subcommittees are developing strategies to enhance communication, public relations, and project funding. Activities have included a guided bus tour of the AOC for elected officials, development of a brochure describing the RAP and PAC, development of this booklet, and presentations by resource experts at PAC meetings. Other focus areas include the Rabbitt River (a major tributary), non-point source pollution abatement, resource education, reuse of contaminated sites, and strategic land use planning/zoning. The PAC meets ten times each year. The public is encouraged to attend and to become active in PAC activities.

The PAC mission statement says that the "Council is to work for the continued improvement and protection of the Kalamazoo River through the wise balance and management of human, economic, and ecological resources. To that end, we seek to work with all parties in a committed, cooperative manner for the improvement of the quality of life within the Kalamazoo River Watershed."

This booklet is Part 1 of a two-part Biennial Report of the Kalamazoo River Remedial Action Plan for the Area of Concern. It is a description of the geographic, geological, biological, and human features and resources of the Kalamazoo River Watershed in the AOC.

Members of the work group of the Public Advisory Council that prepared this booklet include Mark Jenness (Chair), John Bantjes, Bob Beck, Ken Hargie, Judy Mayo, Don McQuitty, Charles Mehne, Patricia Miner, Mike Patterson, Mary Powers, and Bill Wykhuis.

Part 2 is a technical report prepared by members of the MDNR RAP team. It includes detailed descriptions of the impairments, feasibility reports, remedial plans, and supporting appendices.

The Public Advisory Council is pleased to provide this booklet to those interested in the Kalamazoo River. Additional copies can be obtained from PAC members or by contacting the Michigan Department of Natural Resources, Surface Water Quality Division (Phone: 517-335-6970). Copies of the technical report are available from the MDNR.

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Members of the Public Advisory Council

In spring 1995, the following citizen volunteers were members of the Kalamazoo River Area of Concern Public Advisory Council.

Charles J. Mehne, DVM--Chair

Judy Mayo--Vice Chair

Patricia Adams

David Armintrout

Robert G. Beck

Al Campbell

Marilyn Chadderdon

Kenneth L. Hargie

George Heffner

William Hinz

Mark Jenness

Dan Klein

Alois Masters

Donald N. McQuitty

Patricia Miner

John Olech

Mary Powers

Jim Richmond

Mary Seymour

William E. Thacker

Bill Wykhuis

Paul Wylie

Scott Hanshue--PAC Coordinator,
Michigan Department of Natural Resources

Renee Kivikko--PAC Meeting Facilitator
Southwest Michigan Land Conservancy

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PERSPECTIVES ON THE RIVER

In the fall of 1990 the Kalamazoo River Partners of the Forum ^{for} Kalamazoo County conducted interviews with leaders from 33 organizations, representing the interests of business, government, education, recreation, and the general public. The purpose of survey was to inventory existing and proposed development along the river and ask for each community leader's personal visions for the future of the Kalamazoo River. What follows are samples of comments. They indicate the diverse perspectives about the River.

- "We are dealing with three issues when we discuss the Kalamazoo River: water quality, land usage, and land development. Each of these is a massive project in itself."
- "First we need to address the ~~image~~ problem of the River. People still think that it's as bad as in the past. Not the case."
- We have "ignored the river for years. It has been used as a public sewer for years. I believe it is the responsibility of government to provide the people with access to the river so it can be enjoyed."
- "If the river is accessible to people to use for recreational activities, other uses will follow. Expand the Red Arrow Golf Course to the other side of the river. Incorporate housing in and around the course. Establish walkways, bike paths, cross-country ski trails along the river."
- "The Kalamazoo River is a major geographical feature of our region. The river will eventually be discovered in Kalamazoo much as it has been in Allegan and Battle Creek. The river is a great place to recreate whether it is an afternoon canoe ride or a fishing trip."
- "The River's legacy of PCB contamination will be with us for along time. An increased awareness of the River's problems and potential may nurture a sense of stewardship towards this unique natural resource—a resource we might someday be proud to leave our children."
- "Development along the River needs to respect the rights of industry. Without the river, some industries could not function. This needs to be kept in mind when forming a plan for the River."
- "The Kalamazoo River is a major asset of this community which is not being fully utilized. We have a responsibility to raise awareness of what can be done on a coordinated basis."
- "Clean up the river and develop a linear park within the City. The impetus for river development will be the Arcadia Creek project."
- "We need to protect and clean up the river from all aspects of pollution. We should encourage recreational uses, but be sure these aren't contributing to more pollution. Also, we need to be careful to keep the environment beneficial for all users of the river, like farmers who need green space near the river to prevent erosion."

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BACKGROUND

AREAS OF CONCERN (AOC)

Areas of Concern (AOC) are specific geographic areas having degraded environmental quality due to the presence of contaminants and the impairment of the waters, fish and wildlife, or aesthetic values of the resource. There are 43 areas identified in the Great Lakes Basin, including the Kalamazoo River. The Great Lakes Water Quality Agreement, a pact between the United States and Canada, requires the development of a Remedial Action Plan (RAP) for ^{each} Area of Concern.

Map of Great Lakes Basin with all AOC marked

HISTORY OF THE PROGRAM

The Boundary Waters Treaty of 1909 between the United States and Great Britain outlines the rights and responsibilities of the U.S. and Canada with respect to the Great Lakes and established the International Joint Commission (IJC) to advise the two countries on the prevention and resolution of water quality problems in the Great Lakes. The Areas of Concern (AOC) Program was initiated on a basin-wide level in 1985. In 1987, a Protocol was signed that included development of Remedial Action Plans (RAPs) for severely polluted AOCs.

REMEDIAL ACTION PLANS

^{the} Remedial Action Plans (RAPs) are technical management plans that embody a comprehensive ecosystem approach to restoring and protecting beneficial uses in an AOC. RAP is a three-stage process designed to lead to the restoration and maintenance of the chemical, physical, and biological integrity of the AOC. Stage 1 defines environmental problems and identifies their causes, Stage 2 defines water use goals and describes remedial and regulatory measures to meet goals, and Stage 3 confirms restoration of beneficial uses. A RAP indicates when specific actions will be taken to resolve impairments, as well as who is responsible for implementing these actions. RAP teams are made up of environmental and wildlife specialists from state and federal agencies, along with representatives of the AOC Public Advisory Council.

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PUBLIC ADVISORY COUNCILS

In accordance with the international agreement, the public has been involved in the RAP process through the AOC Public Advisory Councils (PACs). In Michigan, PACs are citizen groups formed by the Michigan Department of Natural Resources (MDNR) to advise the MDNR on key aspects of the RAP process, including RAP development, implementation, associated public involvement, and education issues. The PAC also serves as a liaison between those directly involved in the RAP process and the general public, including active involvement in public outreach/education activities and generation of public support for the RAPs.

KALAMAZOO RIVER AREA OF CONCERN

The Kalamazoo River Area of Concern, one of fourteen AOCs in Michigan, extends approximately 85 miles from Morrow Dam in Kalamazoo County to Calkins Dam in Allegan County (see map below).

I thought the AOC goes to the mouth

Small map of Great Lakes Basin with Kal River AOC marked

*of the
River at*

Larger map of AOC

Saug./Douglas

*thought to be primarily
from historical releases*

DESIGNATION AS AN AOC

An 85-mile section of the lower Kalamazoo River in Kalamazoo and Allegan Counties has been identified as an AOC because of ~~historical releases~~ ^{the presence} of polychlorinated biphenyls (PCBs) from deinking operations at local paper mills. Several source areas for the PCB contamination have been identified along the river upstream from the Calkins Dam to the City of Kalamazoo and Portage Creek in the City of Kalamazoo. The upstream sources of PCBs are collectively referred to as the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site and include four separate operable units--Allied Paper-Bryant Mill Pond, Willow Boulevard/A-Site landfill, King Highway landfill, and the 12th Street landfill. The area is listed as a site of environmental contamination and was officially included on the Superfund National Priorities List in August 1990.

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SUPERFUND SITE WITHIN AOC

The Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site is a 35-mile stretch of the Kalamazoo River and a three mile stretch of Portage Creek contaminated with PCBs. This area includes Portage Creek from Crok Street just above Bryant Mill Pond, in the city of Kalamazoo, to its mouth at the Kalamazoo River and from this point downstream to the Allegan City Dam. Because studies show that PCBs have migrated downstream from Allegan and there are upstream PCB-contaminated landfill sources present, the MDNR has expanded their study area to include these locations.

Review
→

Working with the MDNR, the ^{federal} ~~national~~ Environmental Protection Agency, is developing plans for clean-up in the Superfund Site, with some work already begun, including the Auto-Ion site at Mills Street in Kalamazoo and the River.

X

REVIEWERS: THERE NEEDS TO BE MORE ABOUT THE SUPERFUND SITE, ESPECIALLY ITS RELATIONSHIP TO THE AOC

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RESOURCE IMPAIRMENTS

In the RAP process, "Impairments of Beneficial Use(s)" are identified for a particular Area of Concern. Fourteen impairments are used as a "yardstick" of ecosystem health. Because of the PCB contamination, three use impairments have been identified to date within the Kalamazoo River AOC:

- A fish consumption advisory issued by the Michigan Department of Public Health for the following species: carp, suckers, catfish, largemouth bass, and northern pike
- Habitat loss due to sediment contamination
- Dredging restrictions due to PCB sediment contamination

^{team?}
The RAP_A continues to evaluate other potential ecosystem impairments related to agricultural/urban nonpoint sources of pollution and wetland loss/loss of habitat due to development pressures. Details on impairments and progress to date can be found in technical section (Part B) of this Biennial Report.

PROGRESS TO DATE

Identified as a problem in 1971, PCB discharge into the Kalamazoo River has been substantially reduced because of a ban on their production and other regulatory point source controls. In-place contaminated sediments in the upstream areas, however, serve as a source of PCBs for the Kalamazoo River. In June, 1990 the Michigan Department of Natural Resources (MDNR) notified three potentially responsible parties (PRPs)--Allied Paper, Inc./HM Holding, the Georgia Pacific Corporation, and Simpson Plainwell Paper Company--of the MDNR's intent to spend public funds to conduct a remedial investigation/feasibility study. Because of high levels of PCBs and its location in a highly populated industrial and residential area, the Allied Paper/Bryant Mill Pond area on Portage Creek was fenced in 1991.

In August 1990, the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site was included on the National Priority List. The PRPs have agreed to fund and conduct a remedial action/feasibility study (RI/FS) consistent with the Superfund process, committing ^{at least} three million dollars to assure the work will be conducted in a proper and timely manner.

1. to 100
other sources.

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Prior to this, the MDNR completed a RI/FS on the PCB problem in the river in 1986, recommending remedial actions be taken at Bryan Mill Pond, and the Plainwell, Otsego, and Trowbridge impoundments. Further investigation was recommended at Otsego City impoundment, Allegan City impoundment, and Lake Allegan prior to remedial activities. As possible, implementation of remedial actions have been folded into Superfund activities.

ON THE PLUS SIDE . . . Preliminary results from a 1994-95 biological survey of several sites in the river and at the mouths of tributaries show fair to good ratings for overall biological community stability and diversity, measuring fish and macroinvertebrates (insect larvae, snails, crayfish, etc.). Details of this study are presented in Part 2 of this Biennial Report.

Also, study of nutrient levels as part of RAP.

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GEOGRAPHY

GREAT LAKES BASIN

In the United States there are eleven major river systems that define drainage basins (or watersheds), areas drained by a river system. The Great Lakes Basin is drained by the St. Lawrence River. A few statistics:

- The basin stretches 750 miles from New York State to Minnesota, about 550 miles from northern Ohio to central Ontario, and includes the five Great Lakes.
- Total coastline in the U.S. and Canada is 9,400 miles (4,503 miles in the United States; Michigan's Great Lakes coastline is 3,200 miles).
- One fifth of the world's fresh surface water is located in the Great Lakes, 6 quadrillion gallons (5,500 cubic miles), covering an area of 94,000 square miles.
- Twenty percent of the U.S. population, about 40 million people, live in the Great Lakes region; three-fifths of Canada's population--6 million people--live on the Canadian side of the Great Lakes.

KALAMAZOO RIVER WATERSHED

The Kalamazoo River watershed is located in the southwest portion of Michigan's Lower Peninsula and drains about 2,020 square miles from 10 counties--Allegan, Barry, Calhoun, Eaton, Hillsdale, Jackson, Kalamazoo, Kent, Ottawa, and Van Buren. The watershed is about 162 miles long and varies in ~~width~~ ^{width} from 11 to 29 miles. X

The Kalamazoo River Watershed (or Basin) is contained entirely within the Michigan/Indiana Till Plains Ecoregion. Ecoregions are defined using a combination of factors including land use, land surface form, potential natural vegetation and soils. Characteristics of this region include irregular plains (mix of relatively level lands and rolling hills and valleys); potential natural vegetation of oak, hickory, beech, and maple; land use of cropland with pasture, woodland, and forest; and soils of gray-brown podzolic.

There are about 2,450 lakes and ponds totaling 37,500 acres scattered across the watershed, ranging in size from Gun Lake (Allegan/Barry Counties) at 2,611 acres to numerous small ponds. There are 52 lakes or impoundments of 100 acres or more in size. A summary by county is show below.

County	Number of Lakes over 100 Acres	Total Surface Acres
Allegan	17	5,510
Barry	11	5,560
Kent	0	0
Calhoun	12	2,360
Eaton	1	130
Hillsdale	0	0
Jackson	2	340
Kalamazoo	9	3,880
Ottawa	0	0
Van Buren	0	0
WATERSHED	52	17,780

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KALAMAZOO RIVER AND ITS TRIBUTARIES

The North and South branches originate within a few miles of each other--the North Branch heading in Farewell and Pine Hills lakes in southern Jackson County and the South Branches rising in marshy areas south of Moscow in northeastern Hillsdale County. The two branches join at Albion, forming the mainstream that then flows northwesterly for approximately 123 miles before entering Lake Kalamazoo and eventually Lake Michigan near Saugatuck. Along the way, the river flows through several municipalities--Marshall, Battle Creek, Augusta, Galesburg, Comstock, Kalamazoo, Parchment, Plainwell, Otsego, Allegan, and Saugatuck.

Map of river and major tributaries

There are an uncounted number of tributaries and drains that discharge into the Kalamazoo River and its tributaries. Major tributaries are listed below. Lengths are shown in miles. Those with an (*) are within the Area of Concern.

North Branch Kalamazoo River	28.0	Spring Brook*	6.0
South Branch Kalamazoo River	43.0	Gun River *	13.0
Rice Creek (North and South Branches)	29.5	Miner Creek*	7.0
Wilder Creek	10.5	School Section Creek*	3.0
Seven Mile Creek	4.0	Schnable Brook*	4.0
Wabasco Creek	16.0	Swan Creek*	16.5
Battle Creek River	46.0	Bear Creek*	6.5
Wanadoga Creek	12.0	Sand Creek*	3.5
Indian Creek	9.0	Mann Creek*	6.0
Big Creek	6.0	Rabbit River*	46.5
Augusta Creek	15.0	Little Rabbit*	14.0
Portage Creeck (includes West Branch)*	18.5	Red Run Drain*	7.0
Pine Creek*	6.0	Black Creek*	15.0
Baseline Creek	4.0	Miller Creek*	7.0
Sand Creek	4.0	Miller Creek*	3.5
		Silver Creek*	2.0
		Green Lake Creek*	7.0

The **North Branch** above Concord is a small, clear water stream that varies in size from ten feet wide by four inches deep below Farewell Lake to 35 feet wide by one foot deep above the Concord impoundment. The bottom type, in general, through this stretch of stream is sand with some areas of gravel.

The **South Branch** from Homer to Albion is a larger river averaging 40 feet wide by 18 inches deep in the upper areas to 70 feet wide by two feet deep in the lower areas. There are a few flat areas in marsh situations where the river may widen up to 100 feet and the water is quite shallow (eight inches or less). Bottom types are mostly sands and gravel with some rubble and boulders in the riffle areas.

More than half the length of the mainstream between Albion and Ceresco (east of Marshall) is impounded or heavily developed in the cities of Albion and Marshall. The mainstream of the Kalamazoo River from Ceresco to the southwestern edge of Battle Creek flows through

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scenic natural areas and includes several islands. The river is about 80-100 feet wide and averages 1-2 feet deep. Although the bottom has many areas of gravel and aquatic weeds, the river through Battle Creek and adjacent suburbs is almost entirely within developed areas. The Fort Custer Recreation area is in the area between Battle Creek and Augusta. 7

From Augusta to Galesburg there is little development, except in the villages. The river is wide and deep, averaging 110 feet wide and four feet deep. Low stream banks are well vegetated with soft maple, willow, and ash. Between Galesburg and Comstock, the river flows into Morrow Pond, an impoundment created by the Morrow power dam. From this point, the river flows through more urbanized areas of Kalamazoo. From Kalamazoo, the river flows north through natural and agricultural areas to Plainwell. With the river gradient increasing to 2.6 feet per mile between Plainwell and Allegan, five dams were constructed in this stretch of the river (2 have been partially removed). X

From Allegan the river flows into Lake Allegan behind the Calkins power dam. From here it flows through the wildest section of the river--Allegan State Game Area. A major tributary, the Rabbit River, enters the Kalamazoo a few miles upstream from Lake Kalamazoo (the PAC has a subcommittee that focuses on the Rabbit River). As the Kalamazoo River nears its mouth, it flows through extensive marshlands, widening out in Lake Kalamazoo at Saugatuck. The outflow is through a manmade channel, at the end of which the river enters Lake Michigan.

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PHYSICAL FEATURES

CLIMATE

Climate describes the general weather conditions over a long period of time in an area, such as over the course of several years. Michigan, located about half way between the equator and the north pole, has a temperate climate with four distinct seasons over the year. Climate in areas near the Great Lakes, including western parts of the Kalamazoo River Watershed, is also influenced by "lake effects."

Some facts about climate in the Kalamazoo River Watershed:

- Varies from modified marine (Great Lakes influence) in the AOC to continental in the eastern portions
- Average annual precipitation is about 32 inches; average snowfall exceeds 40 inches; in the AOC, annual snowfall approaches 100 inches
- Average July temperature is 72 degrees and average January temperature is about 24 degrees; average January temperature is slightly warmer (26 degrees) near Lake Michigan; annual mean temperature for the area is about 49 degrees
- Average growing season ranges from about 153 days at the eastern end of the watershed to about 184 days along Lake Michigan

GEOLOGY

(Map showing topographic features)

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Geologic History

Ancient Geology. The geologic history of the Kalamazoo River Watershed and that of the Great Lakes Basin are intertwined. The foundation of the present Great Lakes Basin formed about 3 billion years ago during a period of great volcanic activity, followed by a 360 million year period of great deposition materials that became limestone, shales, sandstone, gypsum, and halite (salt). Between the end of this period and about a million years ago, land plants and animals (including dinosaurs) flourished.

Glacial Geology. That part of geologic history most affecting the modern landscape was the glacial period that began about one million years ago. As the climate cooled, snow and ice accumulated to become glaciers (sometimes up to 6,500 feet thick) that inched their way across the Great Lakes region, altering forever the previous landscape. As the glacier moved forward, everything in its path was scraped, crushed, and ground down and frozen in the glacial ice. As the climate warmed again, the ice melted shrinking the glacier and depositing sand, silt, clay, and all sizes of rocks and boulders, collectively referred to as glacial drift. This cycle of glacial formation and retreat was repeated several times, the last being the Wisconsin period.

The action of the glaciers and the deposition of glacial drift left most of the landscape of hills, valleys, flatlands, rivers, streams, and lakes of the Kalamazoo River Basin. Erosion and the effects of human activity have modified the landscape over the last 10,000 years since the end of the last glacial period. The glacial drift extends to a depth of more than 400 feet in the western portions of the watershed to 50 feet or less east of Battle Creek.

Topography

Topography describes the surface features of an area and is often represented on a topographic map showing the elevations of the various land forms (see above). The topography of the Kalamazoo River Watershed has been influenced primarily by glacial activity as described earlier.

The entire region has a generally rolling landscape with flat or gently rolling plains, wetlands and open water, and hilly sections interspersed across the watershed. Glacial surface features include ground and terminal moraines (linear hills or hill systems of poorly sorted material), outwash (course textured material more randomly deposited by the glacier), eskers (materials well sorted by glacial meltwater), and kettle lakes (lakes resulting from massive pieces of ice breaking off the glacier and later melting). Drainage patterns, including those in the Kalamazoo River Basin resulted, in part, from the rising of the land after the glacier receded.

Elevation of a few selected sites in the watershed include: Allegan (629 ft.), Battle Creek (934 ft.), Gull Lake (934 ft.), Jackson (1003 ft.), and Kalamazoo (930 ft.).

Topographic facts about the Kalamazoo River:

- Slow to moderate stream gradient, dropping 540 feet in elevation from its headwaters on the South Branch (1,120 ft. above sea level) to Lake Michigan (580 ft. above sea level). Elevation at the headwaters of the North Branch is 1,042 ft. above sea level.
- The average drop in elevation over the 166 miles of mainstream and South Branch is just over 3 feet per mile.

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- There are approximately 2,450 lakes and ponds totaling 37,500 acres ranging in size from Gun Lake at 2,611 to small ponds. There are 52 lakes or impoundments of 100 acres or more in size, totaling 17,780 acres of surface area.
- The watershed contains approximately 542 linear miles of major streams (34 identified as major). There are many other small streams and drains. *streams*

X

Within the Area of Concern, low areas along the River, referred to as valley plains, are mostly old glacial drainageways not more than a mile or two wide and traversed by streams. Since earlier glacial activity, some streams have cut a lower plain a few feet deep, now covered by more recent flood plain deposits and intersected, in places, by streams flowing into the River. Although dry in places, most of these flatlands have a high water table, large areas of muck soil with wet sandy loams and loams of medium fertility, and "swampy" land bordering the river channel.

The Michigan Natural Features Inventory (March 1994) lists two unique geological features for Kalamazoo County--drumlin and pitted outwash. Formed by glacial action, *drumlins* are elliptically shaped streamlined hills of unsorted mixture of all shapes and sizes of rocks, sand, and other materials. Also glacial in origin, *pitted outwash* refers to areas in front of moraines (hill systems formed by the glacier) with lakes, ponds, and dry depressions.

Soils

Soil is that layer of material on the land's surface made up of varying sizes of rock particles (gravel, sand, silt, clay) and decayed plant and animal matter (humus). Loam is soil with approximately equal parts of sand, silt, and clay. Different loams contain varying proportions of these materials.

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Pie Chart

Soils in the watershed are diverse and as varied as the glacial materials in which they are found. They range from clay and silt to sand and organic materials. About 25% have clay loam or clay textures (found mostly in Eaton County and to a lesser extent in Allegan and Van Buren Counties). Forty percent are sandy loams and loams of intermediate texture (found primarily in Calhoun, Allegan, Barry, and Kalamazoo Counties). Soils with loamy sand and sandy textures make up approximately 30% of the land (found mostly in the western part of the basin). The remaining 5% are organic and are distributed through the basin, usually in river bottoms.

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HYDROLOGY

Hydrology describes the distribution and circulation of water in an area. U.S. Geological Survey show the following about the amount of water moving past three monitoring stations on the River. Discharge is in cubic feet per second (cfs).

MONITORING STATION	PERIOD OF RECORD	AVERAGE DISCHARGE
Battle Creek	1937-1985	664 CFS
Comstock	1933-79, 1985	853 CFS
Fennville	1929-1985	1,430 CFS

The mean monthly flow rates (CFS) to Lake Michigan have been estimated by the Michigan Department of Natural Resources are show in the chart below.

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1620	1740	2370	2490	1990	1500	1200	1030	1030	1180	1500	1620

GROUNDWATER. Groundwater is that water below the land surface, occupying the openings within rocks and between the grains that mke up soils and deposits of clay, sand, and gravel. Once water, seeping through the ground, reaches the water table--the point at which all the openings are filled with water--it begins to move with the groundwater, generally from hills to adjacent stream valleys or lakes. Contaminated groundwater can, in some circumstances, directly affect the quality of water in the Kalamazoo River and its tributaries. Contamination sites have been identified in the counties in the watershed; several are associated with groundwater contamination.

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BIOLOGICAL FEATURES

ECOLOGY OF THE WATERSHED

Climate, soil types, and topography combine to provide conditions that support a variety of natural and human-made communities. The influence of Lake Michigan in moderating the climate of the region has resulted in several plant species being found in the watershed that would otherwise not be present, as well as certain types of agriculture that flourish because of the moderating effects. Plants and animals, as well as plant communities, common in the Midwest are found in the watershed. Additionally, many unusual species--included some endangered, threatened, and of special concern, are also found. Certain locations in the watershed--public and private lands--are prime natural habitats for both common and unusual species of plants and animals. Examples include Allegan State Game Area, Kalamazoo Nature Center, Baker Sanctuary, and Barry State Game Area. A summary of flora and fauna of the watershed is presented below.

NATIVE PLANT COMMUNITIES

There are six major ^{distinct} types of native plant communities in the watershed (described below). While each is a ~~distinct~~ community, there are many transitional zones (called ecotones) that exist between these communities. Some of the dominant species are found in many different communities and may be prevalent in more than one area.

Community	Characteristics
<i>Dry Southern Hardwood Forest</i>	Forests of dry upland sites with burr oak, black oak, or white ash dominating
<i>Moist Southern Hardwood Forest</i>	Forests that occur in moist soils and are dominated by beech and sugar maple
<i>Wet Lowland Forest</i>	Forests characterized by willow or cottonwood, or silver maple or ash
<i>Grassland-Savanna Complex</i>	Includes the combination of prairies, sedge meadows and savannas, characterized as treeless or with scattered trees and dominated by grasses or sedges either wet or dry
<i>Marshes and Emergent Aquatic Communities</i>	Treeless areas in which the water table is above the soil surface during most of the growing season
<i>Submerged Aquatic Communities</i>	Essentially lakes and ponds, the dominant plant species in these communities are below or on the water surface

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In the Michigan Natural Features Inventory (March 1994) for Allegan and Kalamazoo Counties, several unique plant communities are listed:

Allegan

Dry Sand Prairie
Dry-Mesic Northern Forest
Dry-Mesic Southern Forest
Great Lakes Marsh
Interdunal Wetland
Lakeplain Wet-Mesic Prairie
Mesic Southern Forest
Oak Barrens
Open Dunes
Prairie Fen

Kalamazoo

Coastal Plain Marsh
Mesic Prairie
Mesic Southern Forest
Prairie Fen
Southern Floodplain Forest

Note: Mesic refers to a habitat with well drained soils but with an ample amount of moisture; a fen is a wetland with saturated muck soils neutral to strongly alkaline.

ANIMAL LIFE

GENERAL. The animal life of the watershed are as varied as the habitats through which the river flows. Animals found in the rich farmlands of Calhoun and Kalamazoo Counties contrast with animals of the oak-pine barrens and wetlands of Allegan County. Both resident and migratory species are important, with nongame and game animals found throughout the watershed. Nongame species, because they are not hunted and are often inconspicuous, do not receive major attention. However, they make up the larger portion of the animal resource and their role in the well-being of the environment is no less important than that of game species. An inventory of animals of the Allegan State Game Area included in a 1992 master plan for the area listed the following:

- 235 birds
- 45 mammals
- 23 reptiles
- 19 amphibians
- 76 fish

so the numbers refer to species?

Important resident game species include the white-tailed deer, cottontail rabbit, fox squirrel, gray squirrel, raccoon, ring-necked pheasant, ruffed grouse, bobwhite quail, and wild turkey. Furbearing mammals common to the watershed are the mink, muskrat, red fox, skunk, opossum, weasel, and woodchuck. Less common mammals are the gray fox, badger, and beaver.

Important species of waterfowl, commonly taking up summer residence, include the mallard duck, black duck, wood duck, Canada goose, blue-winged teal, and American coot. Others, found only during spring and fall migration, include the blue goose, whistling swan, redhead duck, canvasback, goldeneye, American merganser, bufflehead, lesser scaup, American gallinule, Wilson's snipe, baldpate, pintail, and green-winged teal. The American woodcock is a migratory forest species.

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RARE AND ENDANGERED SPECIES

The Michigan Natural Features Inventory (March 1994) for Allegan and Kalamazoo Counties list plants and animals considered endangered (in danger of extinction in the area), threatened (likely to become endangered in the foreseeable future), or of special concern (not threatened or endangered at present but could be in the future and should be monitored) under state statutes. The chart below summarizes the inventories.

Allegan <u>Endangered</u> : Four plants--Dwarf Burhead, Downy Gentian, Appalachian Quillwort, and Hall's Bullrush; Three animals--Loggerhead Shrike (bird), Weed Shiner (fish), and King Rail (bird) <u>Threatened</u> : 25 plants; 7 animals, including one fish, one amphibian (Marbled Salamander), two birds (Loon and Bald Eagle), and three butterflies <u>Special Concern</u> : 19 plants; 7 animals--one invertebrate, one amphibian (Blanchard's Cricket Frog), one mammal (Woodland Vole), and four reptiles (Massasauga, Spotted Turtle, Wood Turtle, and Eastern Box Turtle)	Kalamazoo <u>Endangered</u> : Four plants--Climbing Fern, Swamp Cottonwood, Cream Wild Indigo, and White Gentian; Five animals--Kirtland's Snake, Weed Shiner, Mitchell's Satyr (butterfly), American Burying Beetle, and Weed Shiner (fish) <u>Threatened</u> : 50 plants; 2 animals--Creek Chubsucker (fish) and Prairie Vole (mammal) <u>Special Concern</u> : 39 plants; 9 animals--three reptiles (Spotted Turtle, Eastern Box Turtle, and Massasauga), 1 amphibian (Blanchard's Cricket Frog), two fish (Spotted Gar and Pugnose Shiner), and two invertebrates <u>Extirpated (no longer found in the area)</u> : Four plants--Pale Duckweed, Dotted Blazing Star, Manna Grass, and Shinner's Three-Awned Grass
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HUMAN RESOURCES

DEMOGRAPHICS

Approximately 400,000 people live in the watershed, with most concentrated in the metropolitan areas of Kalamazoo and Battle Creek. There are 21 cities and villages, located on the River or a tributary, and all or part of 76 townships in the watershed. Other population centers (1990 census figures in parentheses), in addition to Kalamazoo (80,277) and Battle Creek (53,540), include Portage (41,042), Albion (10,066), Marshall (6,891), Charlotte (8,083), Plainwell (4,057), Otsego (3,937), and Allegan (4,547). There are both urban and rural minority populations, including African Americans and Hispanics. Small Native American communities are found in Allegan County.

There are all or part of 31 public school districts, all or part of four community college districts (Jackson, Kellogg, Kalamazoo, and Grand Rapids), one public university (Western Michigan University), and three private colleges (Albion, Kalamazoo, and Davenport).

All or part of three U.S. Congressional districts, _____ State Senate districts, and _____ State Representative districts are included in the Kalamazoo River Watershed. There are 18 circuit court judges, 20 district court judges, and nine probate court judges serving the area. Because parts of ten counties are in the watershed, there are 10 prosecuting attorneys, sheriffs, county clerks, registers of deeds, and treasurers serving the watershed. Each county, city, village, and township also has elected officials, as well as several regulatory and advisory agencies and boards, such as the drain commissioner, health department, planning divisions, and zoning commissions.

LAND USE

There are 2,020 square miles of land in the Kalamazoo River Watershed, approximately 1.3 million acres. There are a variety of agricultural, forest, commercial, industrial, and residential uses.

Distribution by Major Use

Cropland and Pasture--57%
Forest Land--21%
Urban Areas--8%
Wetlands--3%
Open Water--2%
Other Uses--9%

Land Ownership

public?

Of the total acreage, 96% is privately owned. The approximately 48,000 remaining acres are publicly owned. Major areas include Allegan State Game Area (44,000 acres), Fort Custer Recreation Area (3,000 acres), and about one-fifth of the Yankee Spring Recreation Area (1,000 acres). Ownership along the main stream of the Kalamazoo River is 11 linear (22 frontage) miles public and 11 linear (24 frontage) miles private. Linear and frontage miles of the Rabbit River, a major tributary of the Kalamazoo River, are all privately owned.

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Assessed Valuations for Three Counties

(Note: Major portions of these three counties are in the watershed, but some of the value lies outside it; small portions of 8 other counties are in the watershed and are not represented here.)

COUNTY	AGRICULTURAL	COMMERCIAL and INDUSTRIAL	RESIDENTIAL
Allegan	178,835,769	220,476,273	858,943,143
Calhoun	118,259,800	354,453,585	929,901,214
Kalamazoo	84,122,899	910,667,277	1,979,739,345

from 1993-94 Michigan Manual

AGRICULTURE

The agricultural enterprise in the Watershed is extensive and varied. Major grain crops include corn, soybeans, wheat, and oats. Considerable land is also used for pasture and growing alfalfa. Major fruit crops include apples, peaches, pears, blueberries, and strawberries. Some truck farming is also found in the Watershed. Specialty crops/products include maple syrup, honey, wines and fruit juices, bedding plants, nursery stock, and Christmas trees. Dairy and beef cattle, sheep, and pigs are also raised in the Watershed. Poultry farms produce chickens, turkeys, and eggs.

INDUSTRIAL/COMMERCIAL

TO BE WRITTEN

RESIDENTIAL

Urban, suburban, and rural residential areas are found in the Watershed. A variety of housing types are also found--single-family homes, apartments and major apartment complexes, planned unit development communities, and senior citizen and other residences and cooperatives.

TRANSPORTATION

Automobile, truck, train, and airplane transportation is readily available in the watershed. A major portion of Interstate 94 traverses the watershed from Jackson to Kalamazoo. Major intersections include Interstate 69 at Marshall and U.S. 131 at Kalamazoo. Lesser state highways include M-89 from Battle Creek to Allegan, M-43 and M-96 in Kalamazoo County, M-99 and M-60 in Calhoun and Jackson Counties. Amtrack parallels Interstate 94 from Jackson to Kalamazoo. Primary air passenger service is at Kalamazoo, with major air freight service from Battle Creek. Local airports include ones at Albion, Marshall, Plainwell, and Allegan.

RECREATIONAL USES

Outdoor recreation facilities abound in the Watershed. Thousands of campsites, ranging from rustic tent sites to modern trailer/recreation vehicle sites, are found in private and

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public campgrounds. Private recreational facilities provide a variety of services, including golf courses, archery ranges, horseback riding, boat and canoe rentals, marinas, Great Lakes charter boat services, fishing ponds, skiing, snowmobiling, and sledding. Several parks and launch sites allow direct access to the Kalamazoo River.

Two state parks and a major state game area are located in the Watershed. Fort Custer Recreation Area, 2,960 acre state park, is located on the Kalamazoo River between Kalamazoo and Battle Creek. Yankee Springs Recreation Area, a 5,000 acre state park (of which about 1,000 acres are in the Watershed along the Gun River tributary), is located northeast of Plainwell. The Allegan State Game Area, with 44,290 acres, is the largest state-owned area in the Watershed and is traversed by the Kalamazoo River. Other state-owned recreational properties in the watershed include a portion of the Kal-Haven Trail Sesquicentennial State Park and miscellaneous game areas. Fort Custer, Yankee Springs, and Allegan provide day-use and overnight facilities.

There are several county parks. Major ones include Maple Glen and Coldbrook in Kalamazoo County, Littlejohn Lake, _____ in Allegan County, and _____ in Calhoun County. City/village parks and river walks providing access to the River are found in Albion, Marshall, Battle Creek, Kalamazoo, Parchment, Plainwell, Allegan, and Saugatuck.

Notre Dame

X

Department of Natural Resource launch sites on the River are located at _____. There are _____ launch sites at lakes in the Watershed.

NATURAL AREAS

In addition to the state parks and game areas described above, several privately owned nature areas/preserves are found in the Watershed. Sites with major visitor facilities include the W.K. Kellogg Biological Station at Gull Lake, the Kalamazoo Nature Center, and Binder Park and Zoo. Michigan Nature Conservancy sites include _____. Michigan Nature Association sites include _____. Southwest Michigan Land Conservancy sites include _____. These sites, as well as the state, county, and municipal parks, walkways, and launch sites, provide opportunities to observe the plants, animals, and natural and manmade landscapes of the Kalamazoo River Watershed.

X

CONTAMINATED SITES

in Battle Creek.

TO BE WRITTEN Act 307 & Superfund sites within the watershed?

WATER USE

Industrial/Commercial	to be written
Residential	to be written
Recreation	to be written

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HUMAN HISTORY

ALL TO BE WRITTEN

Humans and the Kalamazoo River: An Introduction

Archaeological Sites

Historic Sites

AN INVITATION

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Invite people to learn about and view the river

Map of locations where river can be accessed

Ways to enjoy the river

Ways to learn about the river

How to take action

How to get involved in PAC activities

SUMMARY OF TECHNICAL REPORT

What is it

What does it include

How to obtain it